problem solver what to do when it is uncertain. The paper discusses a medical expert system called MUM, for Managing Uncertainty in Medicine, that plans diagnostic sequences of questions, tests, and treatments, describes the kinds of problems that MUM was designed to solve, and gives a brief description of its architecture. More recently, an empty version of MUM called MU has been built and used to reimplement MUM and a small diagnostic system for plant pathology. Certain features of MU make it appropriate for building expert systems that manage uncertainty.

An Algorithm for Computing Probabilistic Propositions

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An algorithm for computing probabilistic propositions is presented. It assumes the availability of a single external routine for computing the probability of one instantiated variable, given a conjunction of other instantiated variables. Although the time complexity of the algorithm is exponential in the size of a query, it is polynomial in the size of a number of common types of queries.

Combining Symbolic and Numeric Approaches to Uncertainty Management

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Uncertainty is represented in an assumption-based truth maintenance system (ATMS) by tokens called assumptions, which are used to represent belief in uncertain facts. Given a set of assumptions and a set of inferences that can be drawn from these assumptions and their consequents, the ATMS derives a complete Boolean expression (label) for the truth value of every proposition in the database, expressed in terms of the original assumption tokens. Thus, an ATMS can be viewed as a symbolic algebra system for uncertainty reasoning. Previously, assumptions have always been taken to be truth variables ranging over Boolean truth values. This paper describes a method of attaching numeric certainty estimates to assumptions and deriving numeric truth values from the labels of ATMS propositions. This technique has several major advantages over conventional methods for performing inference with numeric certainty estimates, including improved management of dependent and partially independent evidence, faster run-time evaluation of propositional certainties, and the ability to query the certainty value of a proposition from multiple perspectives.

The Inductive Logic of Information Systems

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An inductive logic can be formulated in which the elements are not propositions or probability distributions, but information systems. The logic is complete for information systems with binary hypotheses, that is, it applies to all such systems. It is not complete for information systems with more than two hypotheses but applies to a subset of such systems. The logic is inductive in that conclusions are more informative than premises. Inferences using the formalism have a strong justification in terms of the expected value of the derived information system.

Explanation of Probabilistic Inference for Decision Support Systems

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This paper reports work in progress on an explanation facility for Bayesian conditioning aimed at improving user acceptance of probability-based decision support systems. Design of the facility, which appears to be reasonably domain-independent, is based on an information processing model that accounts for both biased and normative behavior in reasoning about conditional evidence. Preliminary results indicate that the facility is both acceptable to naive users and effective in improving understanding of Bayesian conditioning.

Automated Generation of Connectionist Expert Systems for Problems Involving Noise and Redundancy

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When creating an expert system, the most difficult and expensive task is that of constructing a knowledge base. This is particularly true if the problem involves noisy data and redundant measurements. This paper shows how to modify the MACIE process for generating connectionist expert systems from training examples so that it can accommodate noisy and redundant data. The basic idea is to dynamically generate appropriate training examples by constructing both a "deep" model and a noise model for the underlying problem. The use of winner-take-all groups of variables is also discussed.

These techniques are illustrated with a small example that would be very difficult for standard expert system approaches.

A Measure-Free Approach to Conditioning

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